# United States Patent [19]

**Hansson**

[11] **4,372,534**

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[54] **PNEUMATIC HOIST**


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[51] **Int. Cl.**[3] ..... **B66D 1/08;** B66D 1/48; B66D 3/24

[52] **U.S. Cl.** ..... **254/269;** 254/360

[58] **Field of Search** ..... 254/269, 270, 290, 291, 254/314, 360, 361



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*Attorney, Agent, or Firm*—Frishauf, Holtz, Goodman and Woodward



[57] **ABSTRACT**

A pneumatically operated hoist includes a housing **10** provided with a suspension means **12,13** for suspension of the hoist from an overhead support, a pneumatically driven motor **15** provided with a first flow passage **75** arranged for serving as a pressurized air inlet during raising of a load and as an air exhaust passage during lowering of the load and a second flow passage **76** arranged for serving as an air exhaust passage during raising of the load and a pressurized air inlet during lowering of the load, a load engaging means **16,17** drivingly connected to the motor **15,** and a control means **18** or regulating air flow to and from the motor **15.** Known such hoists of this type are slow in lowering light loads or too fast in lowering heavy loads safely.

According to this invention the control means incorporates a flow restricting means **77,78** provided in said first flow passage **75** and arranged for restricting flow through said first flow passage **75** during lowering of the load, and a load sensitive shunt valve **41** arranged for providing a second air exhaust passage **69,70** during lowering of a load having a weight below a predetermined magnitude and for closing said second air exhaust passage **69,70** during lowering of a load having a weight greater than said predetermined magnitude whereby more efficient operation is obtained.


**11 Claims, 6 Drawing Figures**

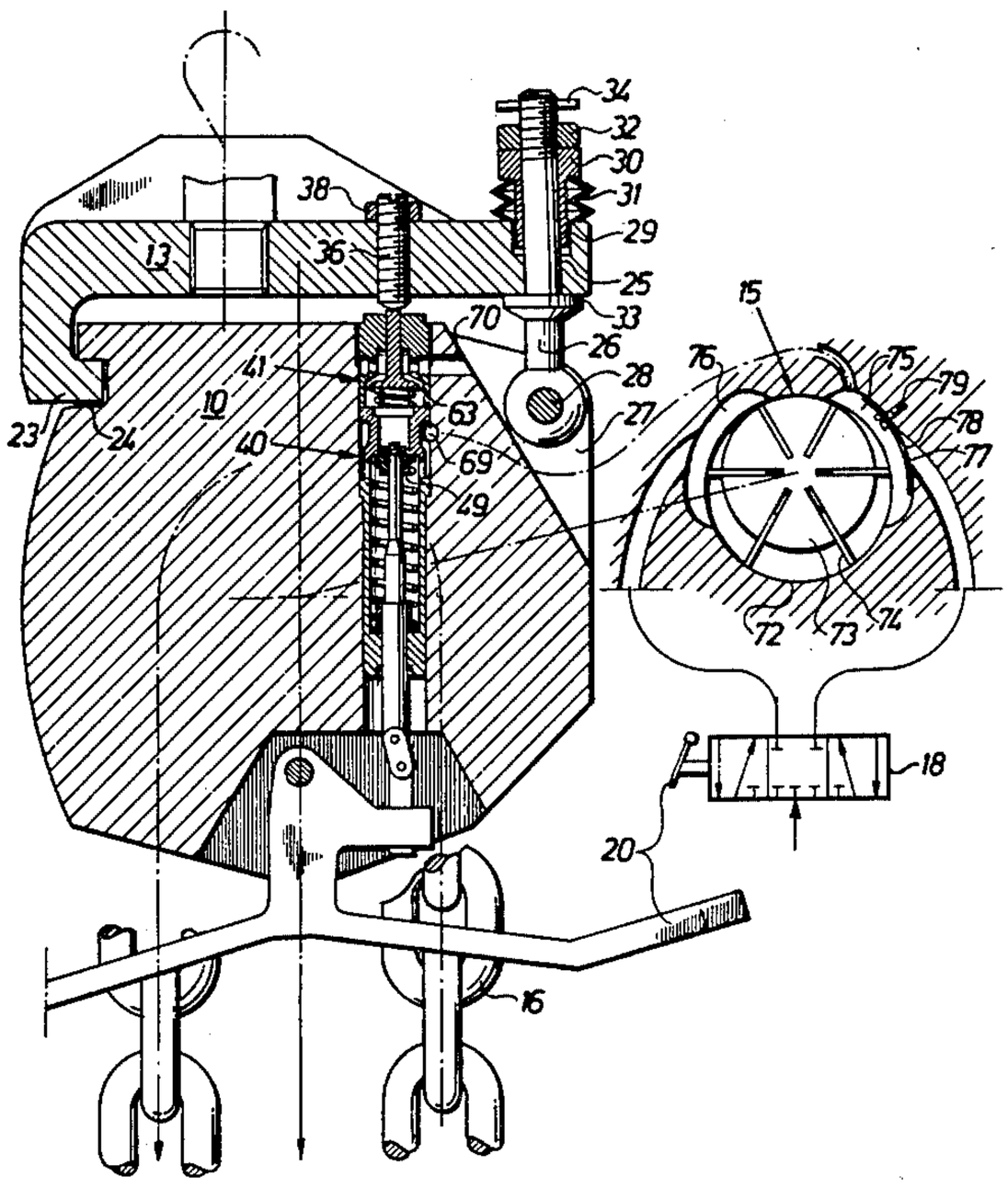

Fig. 1

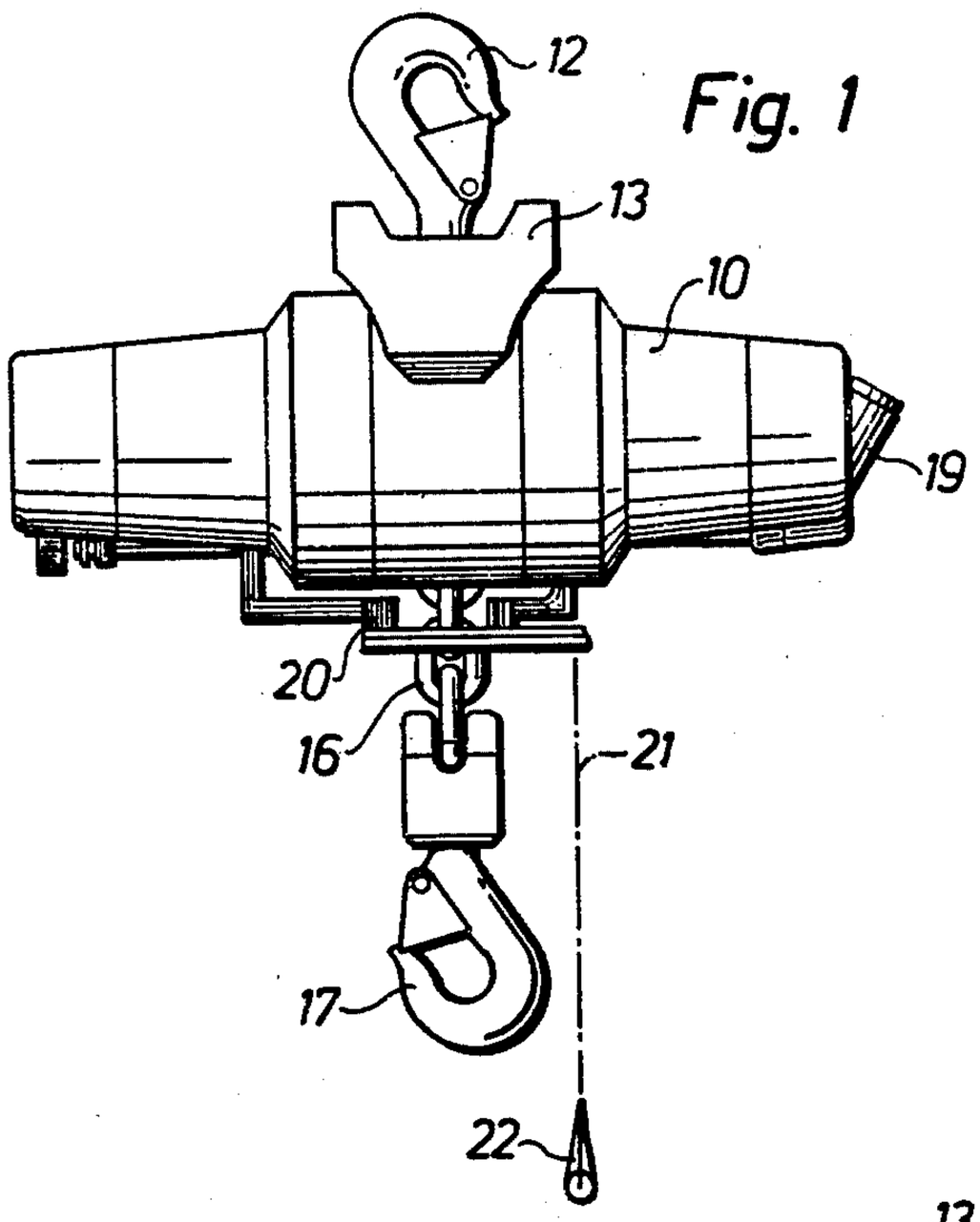


Fig. 6

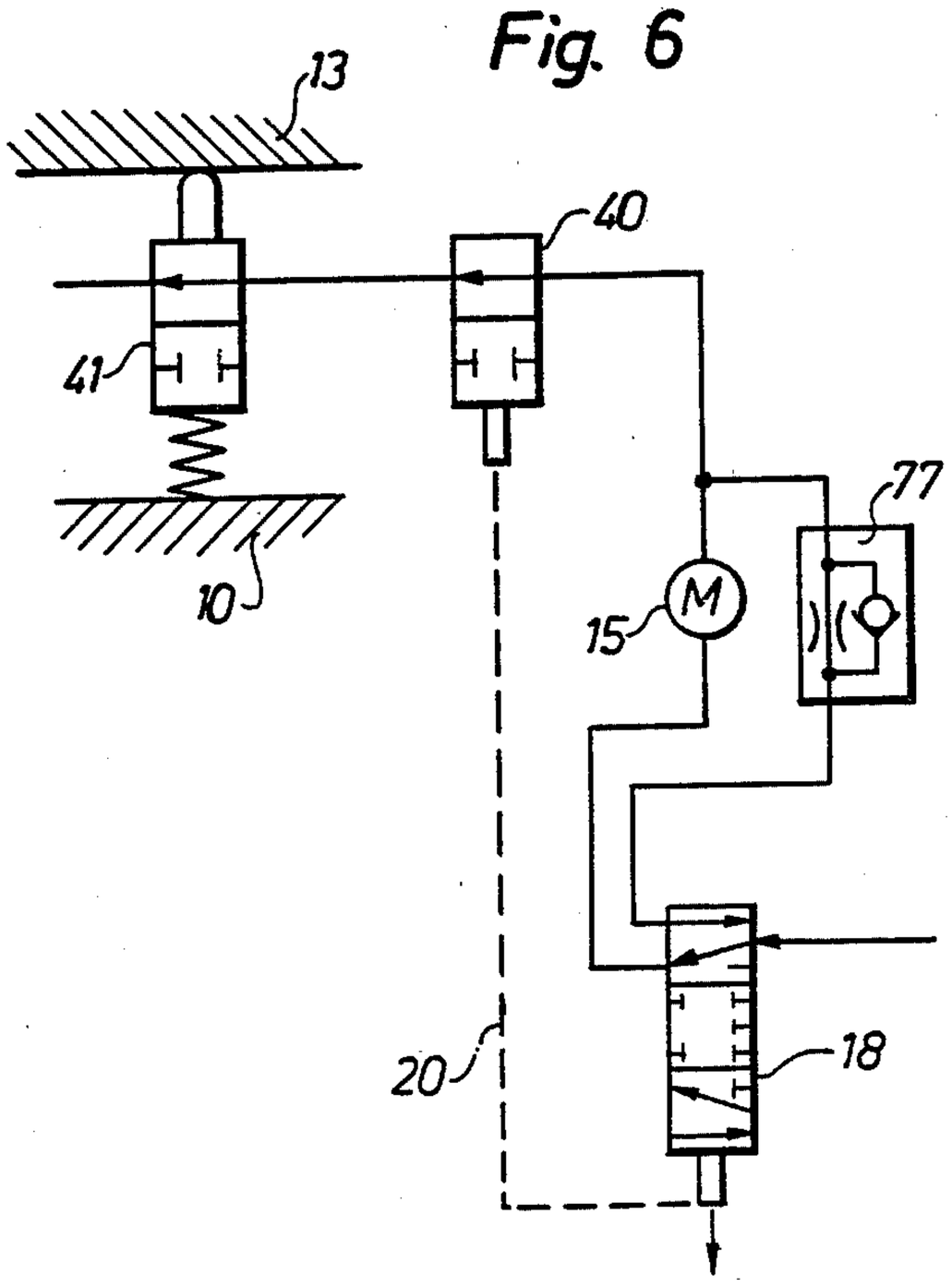

Fig. 2

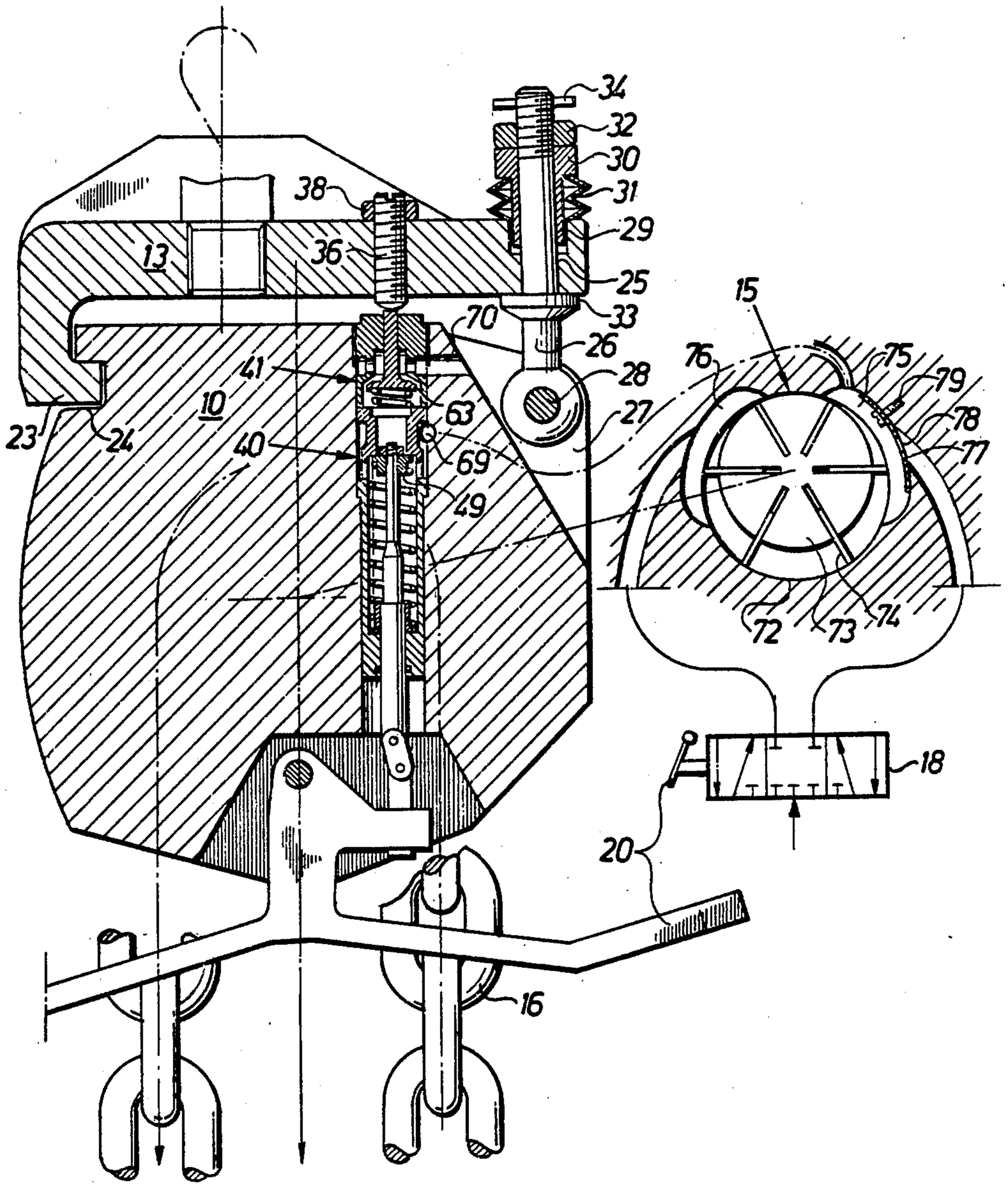
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Fig. 3

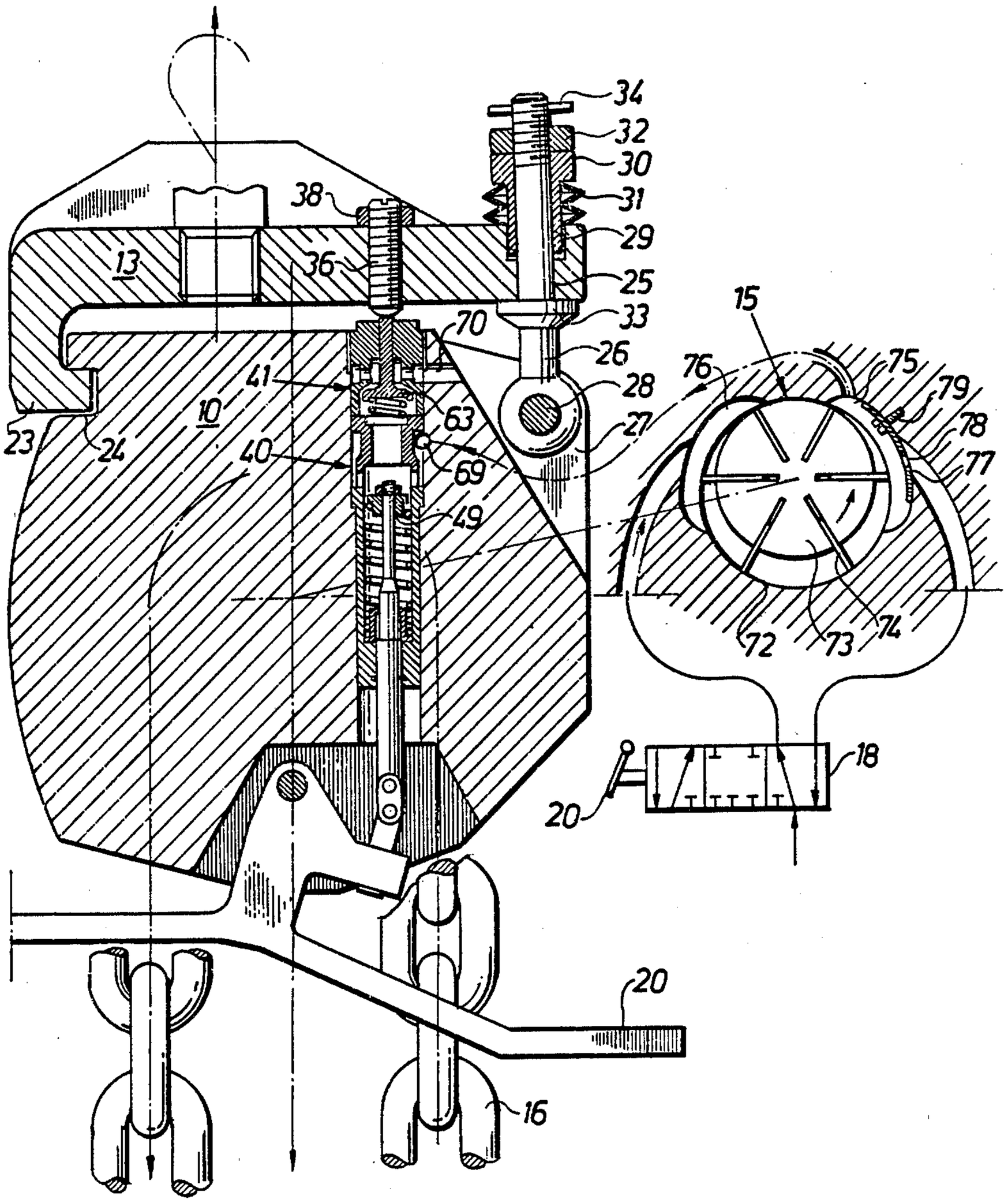
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Fig. 4

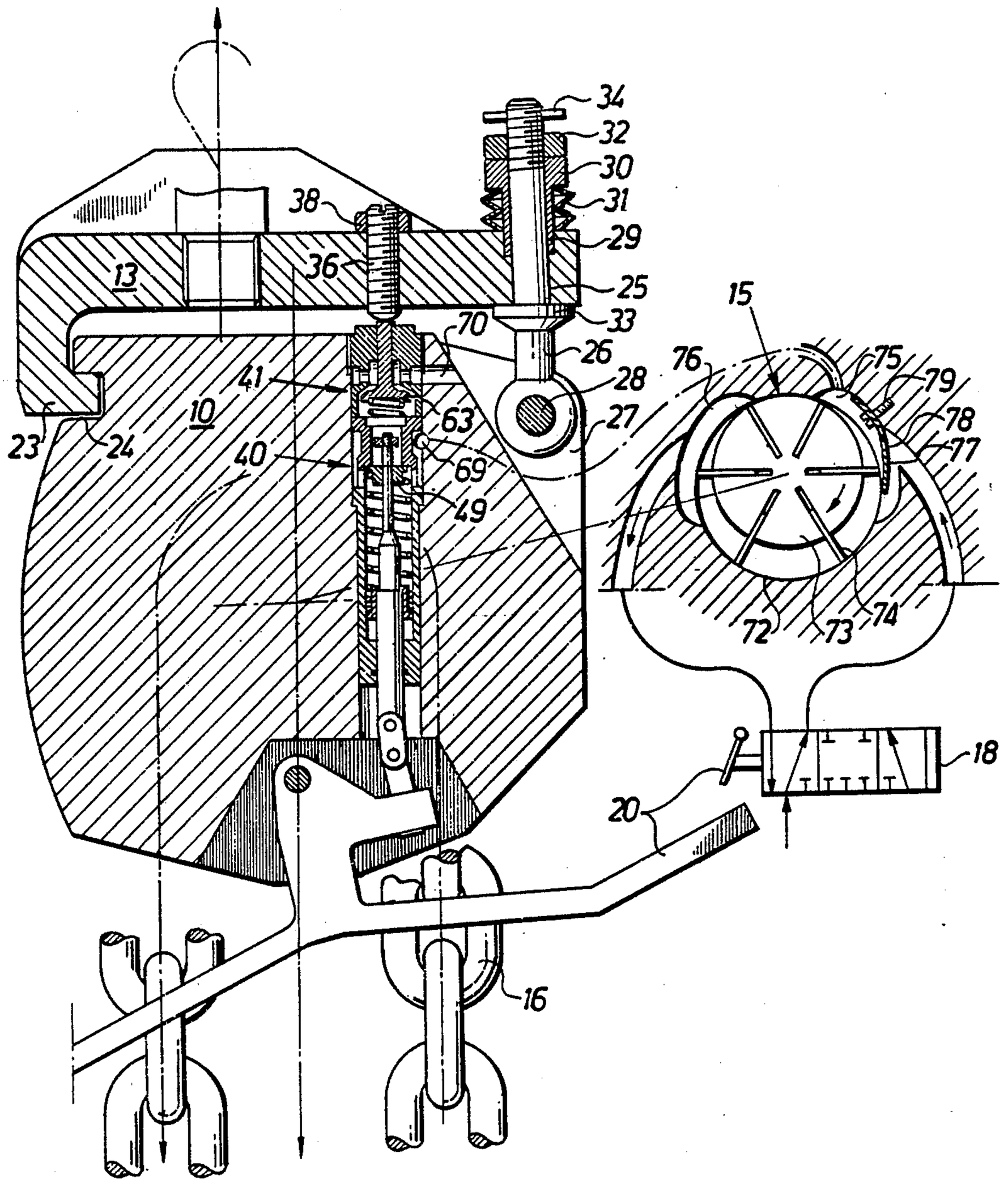
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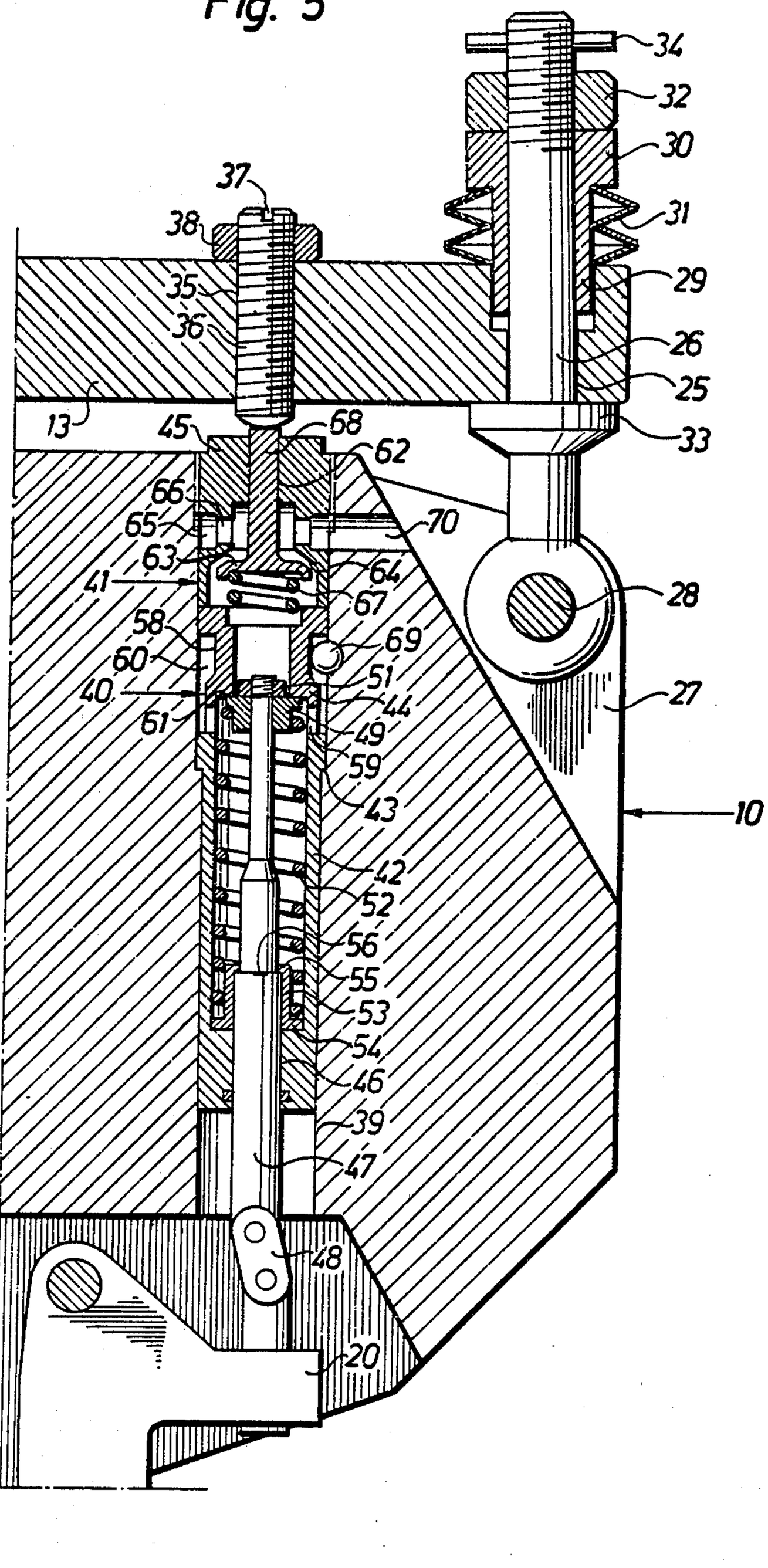
Fig. 5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# PNEUMATIC HOIST

## BACKGROUND OF THE INVENTION

This invention relates to a pneumatically operated hoist comprising a housing provided with a suspension means for suspension of the hoist, in use thereof, from an overhead support, a pneumatically driven motor provided with a first flow passage arranged for serving as a pressurized air inlet during raising of a load and as an air exhaust passage during lowering of the load and a second flow passage arranged for serving as an air exhaust passage during raising of the load and a pressurized air inlet during lowering of the load, a load engaging means drivingly connected to the motor, and a control means for regulating air flow to and from the motor.

In known hoists of the above type it is not possible to provide both fast lowering for speed of operation which is permissible for light loads and slow and safe lowering required for heavy loads, as well as unrestricted load raising power under all load conditions.

It is an object of the present invention to provide a pneumatically operated hoist which overcomes or minimizes such disadvantages.

## SUMMARY OF THE INVENTION

According to the present invention this is accomplished by incorporating in the control means a flow restricting means which is arranged to provide a restriction of the outlet flow from the motor during lowering of the load and a load sensitive shunt valve arranged to provide during lowering of the load a secondary air flow by-passing the flow restricting means when the weight of the load is below a predetermined magnitude.

Thus the present invention provides a pneumatically operated hoist comprising a housing provided with a suspension means for suspension of the hoist, in use thereof from an overhead support, a pneumatically driven motor provided with a first flow passage arranged for serving as a pressurized air inlet during raising of a load and as an air exhaust passage during lowering of the load and a second flow passage arranged for serving as an air exhaust passage during raising of the load and a pressurized air inlet during lowering of the load, a load engaging means drivingly connected to the motor, and a control means for regulating air flow to and from the motor, characterized in that said control means incorporates a flow restricting means provided in said first flow passage and arranged for restricting flow through said first flow passage during lowering of the load, and a load sensitive shunt valve arranged for providing a second air exhaust passage during lowering of a load having a weight below a predetermined magnitude and for closing said second air exhaust passage during lowering of a load having a weight greater than said predetermined magnitude.

With a hoist of the present invention it is possible to provide quick and safe operation by providing fast lowering of light loads and slow lowering of heavy loads without affecting full load raising power, thereby providing improved efficiency and economy of operation.

## BRIEF DESCRIPTION OF THE DRAWINGS

Further preferred features and advantages of the invention will appear from the following description given by way of example of a preferred embodiment



illustrated with reference to the accompanying drawings in which:

FIG. **1** is a side elevation of a pneumatically operated hoist of the invention;

FIG. **2** is a schematically vertical cross section of the hoist of FIG. **1**, the air motor and selector valve being shown in inset views for the purpose of clarity and the control means being shown in its neutral position;

FIG. **3** is a corresponding view to that of FIG. **2** but with the control means shown in its high speed load lowering position;

FIG. **4** is another corresponding view but with the control means shown in its load raising position;

FIG. **5** is a corresponding detail view shown on a larger scale and illustrating the construction of the shunt and blocking valves; and

FIG. **6** is a circuit diagram of the control means of the above hoist in its high speed load lowering position.

## DETAILED DESCRIPTION

The hoist comprises a housing **10** which is suspended, in use, from an overhead support such as a trolley mounted on rails or some other fixed or movable structure, by a hook **12** connected to the housing via a yoke **13**. The housing **10** contains a conventional drive means including a pneumatic vane motor **15**, drive transmission means including gear means, and a chain pulley (not shown) for engaging a load carrying chain **16** and brake means (not shown). At its lower end, the chain **16** is provided with a load engaging hook **17**.

The housing **10** also contains control means for governing the operation of the hoist. The control means includes a selector valve **18** supplied with pressurized air via an inlet nipple **19**. The selector valve **18** which is schematically illustrated in FIGS. **2** to **5** is manually operated by means of a rocking frame **20** pivotally mounted on the housing **10** and having two ropes **21** secured at their upper ends to the frame **20** and provided with handle means **22** at their lower ends.

The rocking frame **20** is designed to encircle the load carrying part of the chain **16** so as to be automatically displaced to its neutral position by the load engaging hook **17** as the latter approaches its uppermost position. This feature is a safety arrangement of conventional type and does not form an essential part of the present invention.

As shown in FIGS. **2** to **4**, the yoke **13** has at one end an inwardly horizontally extending lip **23** which engages in a groove **24** in the housing **10**. The lip **23** fits loosely in the groove **24**, thereby permitting a degree of pivoting of the yoke **13** relative to the housing **10** about said lip **23**. At its other end, the yoke **13** has a vertical bore **25** through which a connecting rod **26** extends. The latter is mounted with its lower end in a slot **27** in the housing **10** and is secured to the latter by a bolt **28**.

At its upper end the connecting rod **26** is provided with a sleeve **29** having a radial flange **30**. Between the flange **30** and the upper surface of the yoke **13**, there is inserted a pile of Belleville springs **31**. These washer springs **31** form together a yieldable load transferring means between the hoist housing **10** and the yoke **13**.

The Belleville springs **31** are subjected to a given preload by tightening of a nut **32** screw threadedly engaging the upper end of rod **26**, against the upper end of the sleeve **29**. Under a no-load condition of the hoist the entire preload set by the nut **32** is transferred back to the rod **26** via a rigid annular flange **33** on the latter. A transverse pin **34** is inserted through the upper end of

the bolt **28** to prevent the nut **28** from falling off the latter.

Inwardly of the vertical bore **25** mounting the connecting rod **26**, the yoke **13** is provided with a vertically extending screw threaded bore **35** through which a set screw **36** extends. This set screw **36** is formed at its upper end with a transverse slot **37** engageable by a screw driver and carries a lock nut **38** by means of which the screw **36** can be secured in any desired position.

Substantially coaxially with the set screw **36**, the housing **10** is provided with a vertical bore **39** in which a control valve mechanism is located. This valve mechanism comprises a blocking valve **40** operatively connected with the rocking frame **20** and a shunt valve **41** (see FIG. **5** in particular). In this vertical bore **39**, there is mounted a support sleeve **42** supported via a flange at its upper end on a shoulder **43** in said vertical bore **39**, an intermediate sleeve **44** and an upper sleeve **45** screw threadedly engaged in a threaded upper part of the bore **39** so as to axially secure the support and intermediate sleeves **42**, **44** against the shoulder **43**.

At the bottom end of the support sleeve **42**, there is provided a guide bore **46** through which a blocking valve stem **47** extends. The latter is coupled to the rocking frame **20** via a linkage **48** and carries at its upper end a blocking valve element **40** which is slidable along the stem **47** but is prevented from falling off the stem **47** by a stop nut **51**. A coil type compression spring **52** is disposed to act between the valve element **49** and an outer flange **54** at the base of a reaction sleeve **53** which reaction sleeve **53** has at its upper end an inner flange **55** disposed in abutment with a shoulder **56** on the stem **47**.

The arrangement of the compression spring **52** between the axially displaceable valve element **49** and the reaction sleeve **53** means that the spring **52** is compressed further in the load raising and load lowering positions than in the neutral position of the hoist (see below). This results in an automatic biasing of the selector valve **18** and the rocking frame **20** towards their neutral positions.

The intermediate sleeve **44** rests upon the upper end of the support sleeve **42** and is provided with an external waist **58** which together with the internal wall surface of the housing vertical bore **39** defines an annular chamber **60**. A number of radial openings **59** is provided at the lower end of the intermediate sleeve **44** to establish communication between the annular chamber **60** and the interior of the intermediate sleeve **44**. The latter also has an annular blocking valve seat **61** located above the openings **59** and intended for co-operation with the blocking valve element **49** of the blocking valve **40**, the operation and purpose of which is further described below.

The upper sleeve **45** is provided with an axial bore **62** for guidedly supporting an upper valve element **63** and a valve seat **64** for sealing co-operation with said upper valve element **63**, said seat and element **64**, **63** constituting the shunt valve **41**. The upper sleeve **45** also has an external peripheral groove **65** located above the valve seat **64** and a number of radial openings **66** connecting the groove **65** with the interior of said upper sleeve **45**. A shunt valve coil type compression spring **67** is disposed between the upper end of the intermediate sleeve **44** and the shunt valve element **63** so as to bias the latter towards its closed position.

The valve element **63** of the shunt valve **41** also has a stem portion **68** which projects out of the bore **62** through the upper sleeve **45** and axially abuts the lower end of the set screw **36**.

An air passage **69** extends through the housing from the housing vertical bore **39** at the level of the waist **58** of the intermediate sleeve **44** i.e. from the annular chamber **60** to one of the ports of the vane motor **15**. A further passage **70** extending through the housing connects the peripheral groove **65** of the upper sleeve **45** with the atmosphere.

The vane type drive motor **15** illustrated in FIGS. **2** to **4**, comprises a cylindrical chamber in a motor housing **72** with an eccentrically mounted rotor **73** having a plurality of radially sliding vanes **74** on the rotor **73**, the housing **72** having first and second flow passages including first and second air communication ports **75** and **76** respectively. In use of the motor **15**, the first and second flow passages alternately function as a pressurized air inlet and an air exhaust passage, respectively, depending on the direction of rotation of the rotor **73**.

In the first port **75**, there is mounted a leaf spring valve **77** provided with a restricted diameter opening **78**. The leaf spring valve **77** is clamped at one end to the motor housing **72** by means of a screw **79** so that a pre-load in the closing direction of said leaf spring valve **77** is obtained, whereby the leaf spring valve **77** functions as a back flow restricting valve.

In FIG. **6**, there is shown in diagrammatic form the control system with which the operation of the hoist is governed. The various different valves described above are identified with the same reference numerals in the diagrammatic FIG. **6** as in the other more representational figures.

The mode of operation of the hoist of the invention will now be described with reference both to FIGS. **1** to **5** showing the physical construction and to the diagram of FIG. **6**.

The hoist is suspended by its hook **12** from a suitable overhead structure such as a trolley on rails (not shown), and the air inlet nipple **19** is connected to a pressurized air source. The hoist is now ready for use.

Depending on the weight of the workload attached to the load engaging hook **17**, the Belleville springs **31** are compressed to a greater or lesser extent, the actual setting of the set screw **36**, determining the load level at which the shunt valve element **63** is shifted from its open to its closed position. When the load on the hook **17** is small or non-existent, the Belleville springs **31** are very little compressed which means that the distance between the yoke **13** and the housing **10** is kept small. This means in turn that the set screw **36** holds the shunt valve element **63** depressed against the action of the stunt valve compression spring **67**, and communication between the inside of sleeve **45** and the atmosphere is maintained. This condition obtains in all the figures of the drawings.

In the position of the control means shown in FIG. **2**, the hoist is in its rest position. Accordingly, the handle **22**, the rocking frame **20** and the selector valve **18** are all in their neutral positions. The blocking valve **40** is also closed and the back flow restricting valve **77** occupies its flow restricting position.

In the situation shown in FIG. **3**, the handle **22**, the rocking frame **20** and the selector valve **18** are shifted to their load lowering positions. Thus the selector valve **18** supplies pressurized air to the second port **76** of the vane motor **15** and allows exhaust air from the first port **75** to reach the atmosphere. Because of the fact that in this case the load on the load engaging hook **17** does not

exceed the predetermined value at which the Belleville springs **31** are compressed far enough to cause the shunt valve **41** to close, the second air exhaust passage (**69, 65, 66, 70**) remains fully open and the interior of the upper sleeve **45** is vented to the atmosphere via the radial openings **66**, peripheral groove **65** and second passage **70**. As the rocking frame **20** is shifted to its load lowering position the blocking valve stem **47** is pulled downwardly and the blocking valve element **49** displaced from the blocking valve seat **61**, thereby providing a through communication from the vane motor first port **75** to the atmosphere via the shunt valve **41**. By this means a "second air exhaust passage" extending from the motor **15** to the atmosphere and comprising the air passage **69**, annular chamber **60**, intermediate sleeve radial openings **59**, blocking valve **40** and shunt valve **41** openings, upper sleeve radial openings **66** and peripheral groove **65**, and the further passage **70** through the housing **10**, is established. Thus although in the case of lowering of a light load the normal motor exhaust via the first port **75** is restricted by the valve **77**, the presence of the open "second air exhaust passage" permits an increased motor speed and hence a faster lowering of the load. The same situation is also illustrated in the circuit diagram of FIG. **6**.

If, however, a heavier load is attached to the load engaging hook **17** the Belleville springs **31** will be further compressed and the distance between the yoke **13** and the housing **10** increased so that the set screw **36** will no longer be able to hold the "load sensitive" shunt valve **41** in its fully open position. This will immediately result in restriction or interruption of communication through the "second air exhaust passage" so that most or all of the exhaust flow from the motor has to pass through the restricted diameter opening **78** of the leaf spring valve **77** with the result that the motor speed and hence the load lowering speed are effectively brought down to a slow and safe level.

When shifting the rocking frame **20** and the selector valve **18** to their load raising positions as shown in FIG. **4**, the valve element **49** of the blocking valve **40** is maintained in sealing contact with the blocking valve seat **61** by the action of the associated compression spring **52**. Communication through the "second air exhaust passage" is always blocked, no matter how small a load is attached to the hook **17**. This is however absolutely necessary, because in this situation pressurized air is supplied to the first port **75** to drive the vane motor **15** in its load raising direction and because of this not even a very small pressure leakage through the "second air exhaust passage" would be acceptable. Accordingly, the position of the load sensitive shunt valve **41** has no influence at all upon the air flow through the motor **15** during raising of a load.

In the load raising situation, the leaf spring valve **77** is displaced by the pressurized air supply to fully uncover the first port **75**, so that the incoming pressurized air is able to reach the drive chamber of the motor **15** without passing through the restricted diameter opening **78**. This means that the motor **15** is able to deliver maximum power during raising of loads.

By changing the setting of screw **36**, it is readily possible to alter the weight limit for light loads which can be lowered at increased speed in a quick and simple manner.

I claim:

**1**. In a pneumatically operated hoist comprising a housing (**10**) provided with a suspension means (**12, 13**) for suspension of the hoist, a pneumatically driven motor (**15**) provided with a first flow passage (**75**) arranged for serving as a pressurized air inlet during raising of a load and as an air exhaust passage during lowering of the load and a second flow passage (**76**) arranged for serving as an air exhaust passage during raising of the load and a pressurized air inlet during lowering of the load, a load engaging means (**16, 17**) drivingly connected to the motor (**15**), and control means (**18**) coupled to said motor for regulating air flow to and from the motor (**15**);

the improvement wherein:

said control means includes a flow restricting means (**77, 78**) provided in said first flow passage (**75**) and arranged for restricting flow through said first flow passage (**75**) during lowering of the load; and a load sensitive shunt valve (**4**) arranged for providing a second air exhaust passage (**69, 70**) during lowering of a load having a weight below a predetermined magnitude and for closing said second air exhaust passage (**69, 70**) during lowering of a load having a weight greater than said predetermined magnitude.

**2**. A hoist according to claim **1**, wherein said control means further includes a selector valve (**18**) switchable between a neutral position, a load raising position and a load lowering position; and a blocking valve (**40**) connected in series with said shunt valve (**41**) for controlling the second air exhaust passage (**69,70**) and operatively interconnected with said selector valve (**18**) so as to be shifted from an open position to a closed position as said selector valve (**18**) is switched from its load lowering to its load raising position.

**3**. A hoist according to claim **2**, wherein said suspension means has an abutment means (**36**) thereon; and said shunt valve (**41**) and said blocking valve (**40**) extend generally vertically in the housing (**10**) and coaxially of each other; and said shunt valve (**41**) includes an upwardly extending valve displacement means (**68**) disposed for co-operation with said abutment means (**36**) on said suspension means.

**4**. A hoist according to claim **3**, wherein said abutment means (**36**) comprises an adjustable set screw on said suspension means and arranged for adjustment of the predetermined load weight at which the abutment means displaces the shunt valve (**41**) to its closed position.

**5**. A hoist according to any one of claims **1** to **4**, wherein said flow restricting means (**77,78**) comprises a movable valve element (**77**) displaceable between its flow restricting position for load lowering and a non-flow restricting position for load raising.

**6**. A hoist according to claim **5**, wherein said movable valve element (**77**) of said flow restricting means comprises a leaf spring which is preloaded towards its flow restricting position and which is arranged to be resiliently displaceable to its non-flow restricting position by the pressure of the pressurized air supply through the first flow passage (**75**) during raising of the load.

**7**. A hoist according to claim **1** or claim **2** wherein said suspension means (**12, 13, 26, 31**) includes a resiliently deformable biasing means (**31**) which is arranged to deform under the weight of a load supported on said load engaging means (**16, 17**); and wherein said shunt valve (**41**) is arranged to be displaced by said suspension means (**36, 13**) towards its closed position for closing of said second air exhaust passage (**69, 70**) in response to increased deformation of said biasing means (**31**).

8. A hoist according to claim 7, wherein said suspension means (12, 13, 26, 31) comprises a yoke (13), said yoke (13) being pivotally connected to said housing (10) at one end and being connected at its other end to said housing (10) through said biasing means (31).



9. A hoist according to claim 8, wherein said biasing means (31) comprises a pile of Belleville springs.

10. A hoist according to claim 7, wherein said biasing means (31) comprises a pile of Belleville springs.

11. A hoist according to any one of claims 1–4, wherein said suspension means comprises a yoke (13) for suspension of said hoist from an overhead support.

* * * * *